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MET O 11 TECHNICAL NOTE NO 98

# A COMPARISON OF THE MET O 20 11 LEVEL MODEL WITH THE 10 LEVEL $\sigma$ MODEL WITH AND WITHOUT PHYSICS

M J P CULLEN

Meteorological Office (Met O 11)
London Road
Bracknell
Berkshire
United Kingdom

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NB. This paper has not been published. Permission to quote from it should be obtained from the Assistant Director of the above Meteorological Office branch.

1. Introduction. This note describes one of a series of experiments which are currently being conducted to investigate the differences between the operational 10 level model and the Met O 20 11 level model. The purpose of this experiment was to find out if the different parameterisation of physical processes, boundary-layer effects, convection and radiation; was a primary cause of the differences sometimes observed between the forecasts produced by the models. In order to do this four cases were selected where the 10 and 11 level models gave noticeably different results over the Atlantic sector by day 3. In each of these cases the experimental $\sigma$-coordinate version of the 10 level model gave similar results to the operational 10 level model, so the $\sigma$ version was used in the experiments. The cases were then rerun to 3 days with all physical processes removed. On only two occasions did a forecast fail to reach 3 days without physics. The results from the 10 and 11 level models without physics were then compared to see if the differences persisted. The cases were chosen to cover summer and winter circulations and the results from one summer and one winter cases are discussed in detail.

2. Results. The cases chosen were as follows (all from 1977): 20 February, 27 March, 29 May, 14 August. The cases from 20 February and 14 August are illustrated; the conclusions from the other two cases are similar.

The 20 February case is illustrated in Figs 1 to 4. There are substantial differences in the 2 forecasts with physics (Figs 2 and 2) over the USA by day 2. The differences are best seen in the PMSL field. In the 10 level model there is a depression of 980 mb at 55N 55W with a weak ridge to the west of it. There is then a strong southerly flow at 90–100W caused by a very elongated low and trough to the NE of the Rockies. In the 11 level model the E Canadian low is at 55N 60W with a central pressure of 968 mb, to the west of it is a secondary centre of 992 mb, instead of the ridge predicted by the 10 level model. The flow at 100W is mostly north-westerly because the Alaskan low now links across Canada to the Great Lakes secondary, instead of elongated further to the SW. Elsewhere on the chart the differences are small.

The two forecasts for the same time without physics are shown in Figs 3 and 4. The essential difference between the forecasts over the USA remains, in that the 10 level model predicts a ridge at 80W over Canada while the 11 level model predicts a secondary low. All the surface features are more intense in the integrations without physics but changes in shape or position are generally slight. However, the elongated trough at 100W in the 10 level model is further east and extends less far south without physics. In the 11 level model the spurious low centre at 40N 105W is weakened and the high at 45N 110W is stronger and further east, closer to its position in the 10 level forecase.

The results from the 14 August case are shown in Figs 5 to 10. The main difference between the 10 and 11 level models is in the handling of a developing depression south of the British Isles and the movement of an associated 500 mb trough. The difference is clearer at 500 mb so the 3 day forecast for this level is shown. The 10 level model shows a large amplitude ridge extending from 50N 5E to 80N 25W with a small trough at 15W at 50N. In the 11 level forecast the main ridge is further west at all latitudes, it extends from 50N 5W to 80N 45W and merges with the Central Atlantic ridge at 30W. The trough to the west of the British Isles is cut off and extends further south than is the 10 level model, contour heights being up to 10 dn lower. In fact the 10 level forecast was more accurate, though both models were slow in handling the developments.

The two forecasts without physics are shown in Figs 7 and 8. The major differences remain, though there are differences in detail.

Figs 9 and 10 show the surface pressure forecasts from the 11 level model only for 73 days from the 14 August. In general intensities are increased in the run without physics. However areas of low pressure forecast incorrectly over land areas, for instance, the south-west USA and North Africa, are removed in the integration

without physics. These low pressure areas are observed to be a persistent fault of the current version of the 11 level model in summer.

3. Conclusions. These experiments show that where significant differences appear between the forecasts from the $\sigma$ -coordinate 10 level model and the Met O 20 11 level model appear within 3 days that they are unlikely to be caused by differences in the treatment of physical processes. Other experiments are being carried out to see if they can be explained by differences in the dynamics, or whether they should be put down to initial data.

ACKNOWLEDGMENT

This experiment has involved cooperation from several branches of the Meteorological Office, particularly from Dr A J Gadd for the $\sigma$ -coordinate 10 level results and Mr N J Saker for the 11 level model results.

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Fig 2 As Fig 1 using 11 level model.

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Fig 6 As Fig 5 using 11 level model.

Fig 7 As Fig 5, without physics.

Fig 8 As Fig 6, without physics.

Fig 9 Three day PMSL forecast from 14.8.77 using 11 level model.

Fig 10 As Fig 9, without physics.

FIG. 1

10 LEVEL

DT 12Z 20/02/77 VT 12Z 22/02/77 T+48 SURFACE PRESSURE (4MB INT) UPDATE

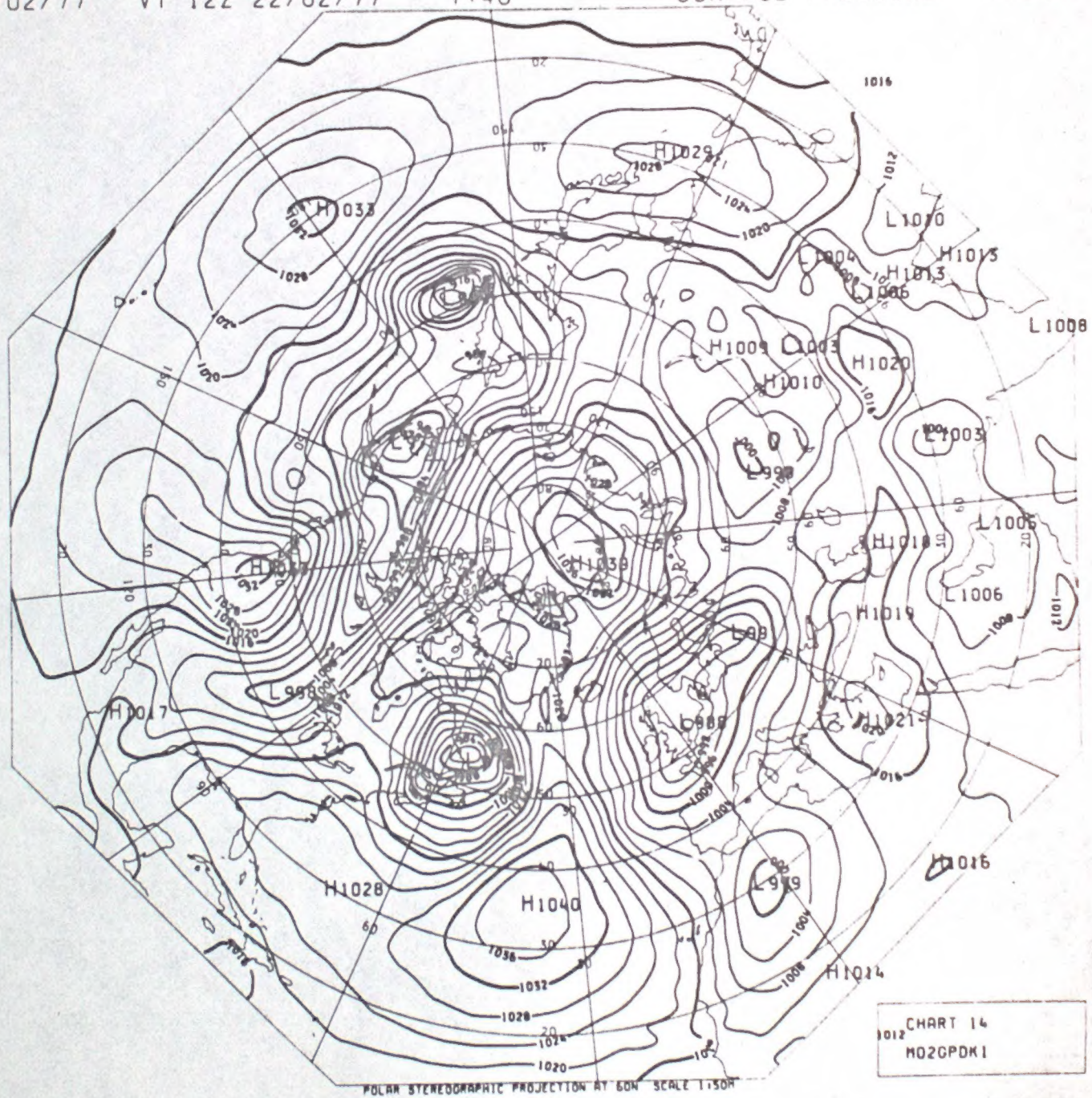

FIG. 2 11 LEVEL

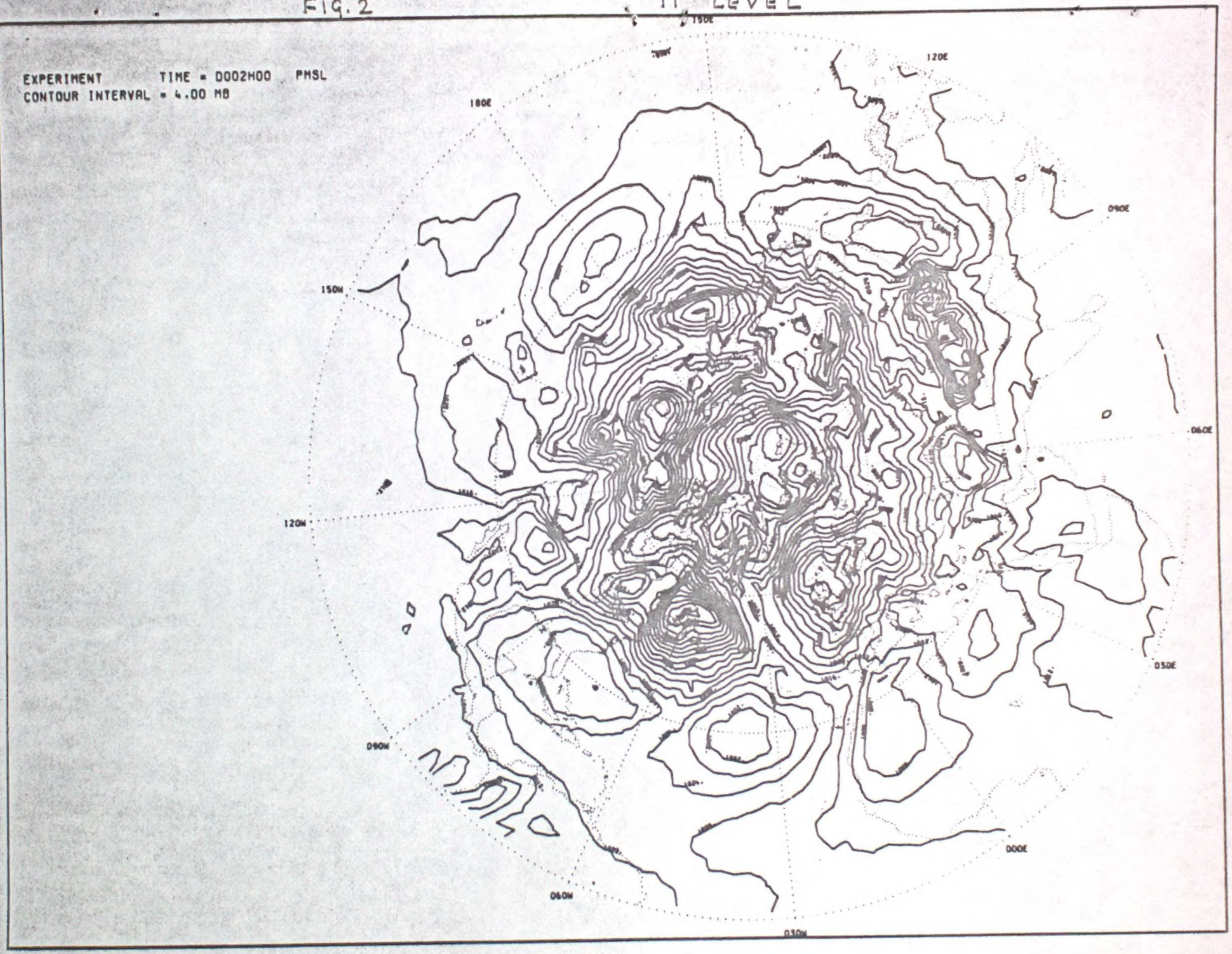

FIG. 3 10. LEVEL NO PHYSICS

DT 12Z 20/02/77 VT 12Z 22/02/77 T+48 SURFACE PRESSURE (4MB INTI UPDATE

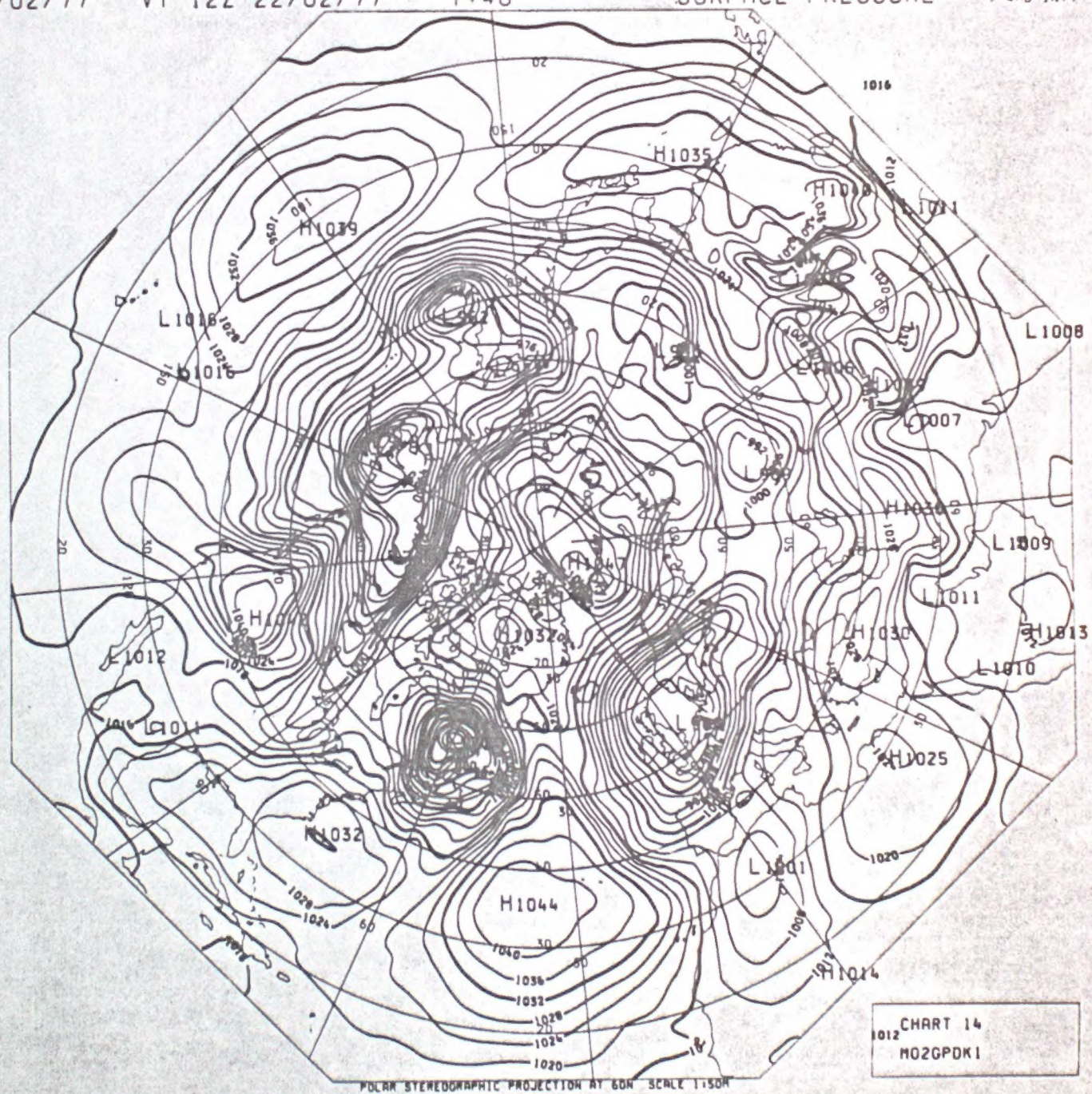

FIG. 4. 11 LEVEL NO PHYSICS

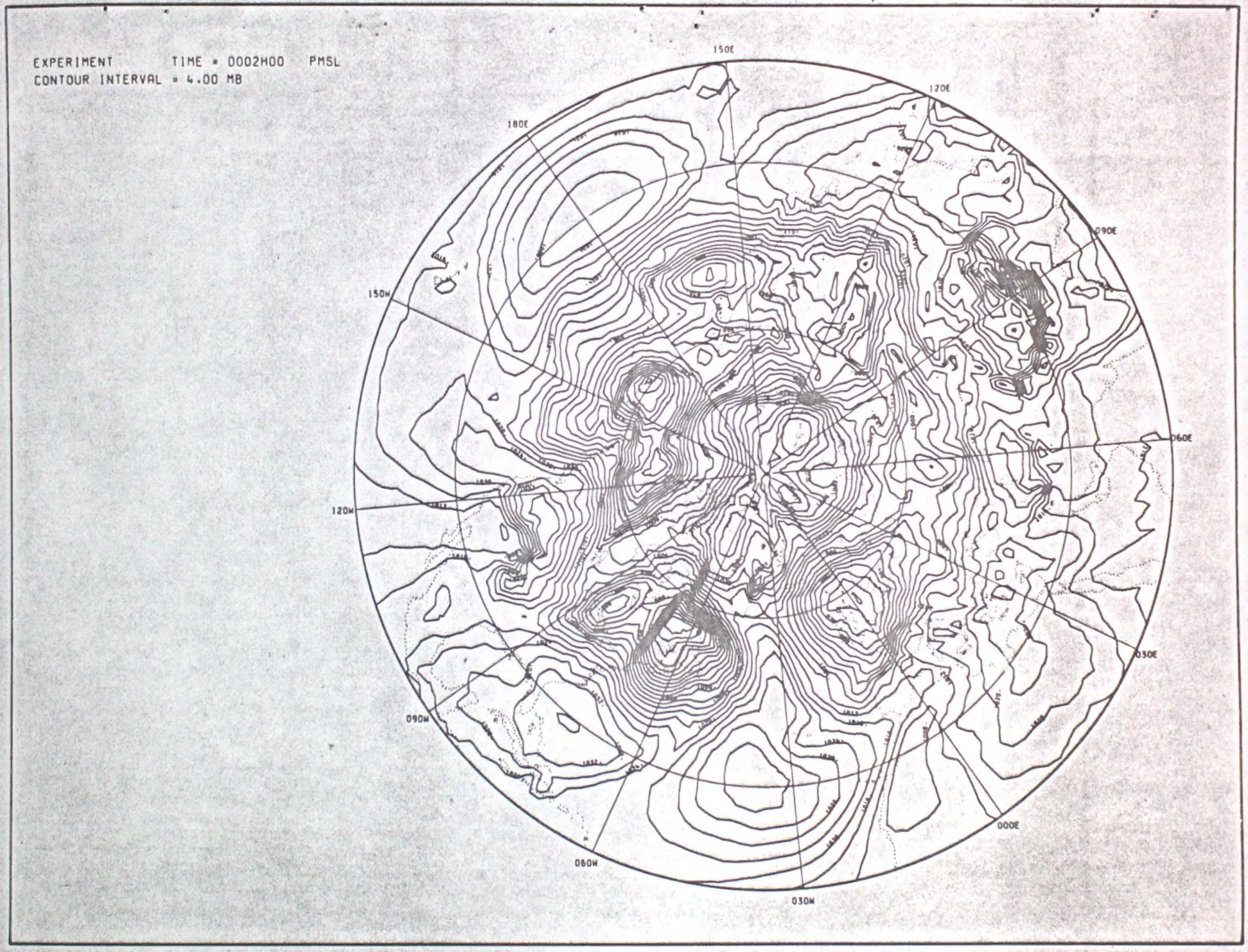

FIG. 5 10 LEVEL

DT 12Z 14/08/77 VT 12Z 17/08/77 T+72 500 MB HEIGHT

( 60M INT ) UPDATE

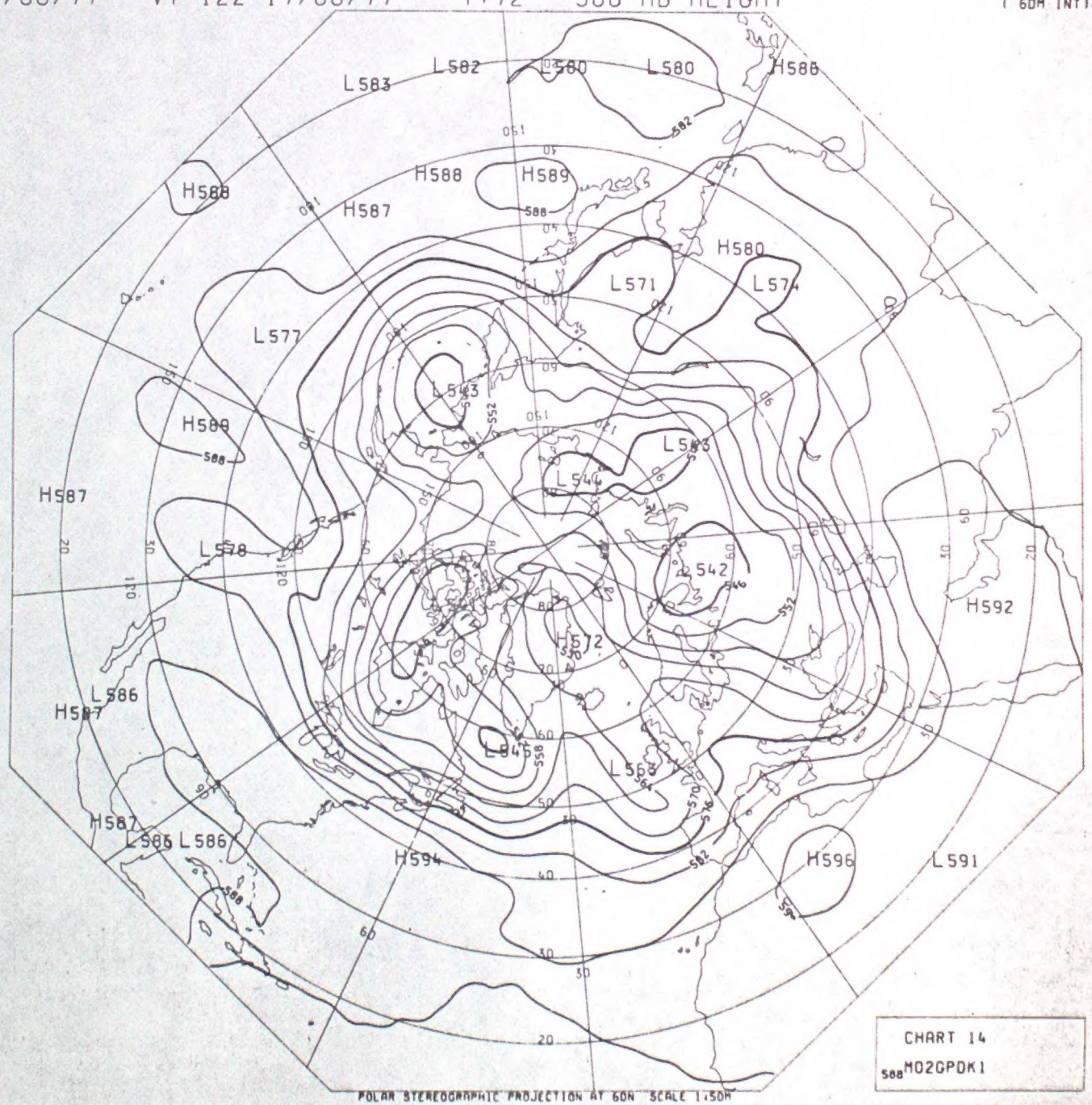

FIG. 6 11 LEVEL

EXPERIMENT TIME = 0003H00 500 MB HEIGHTS
CONTOUR INTERVAL = 6.00 DEKAMETRES

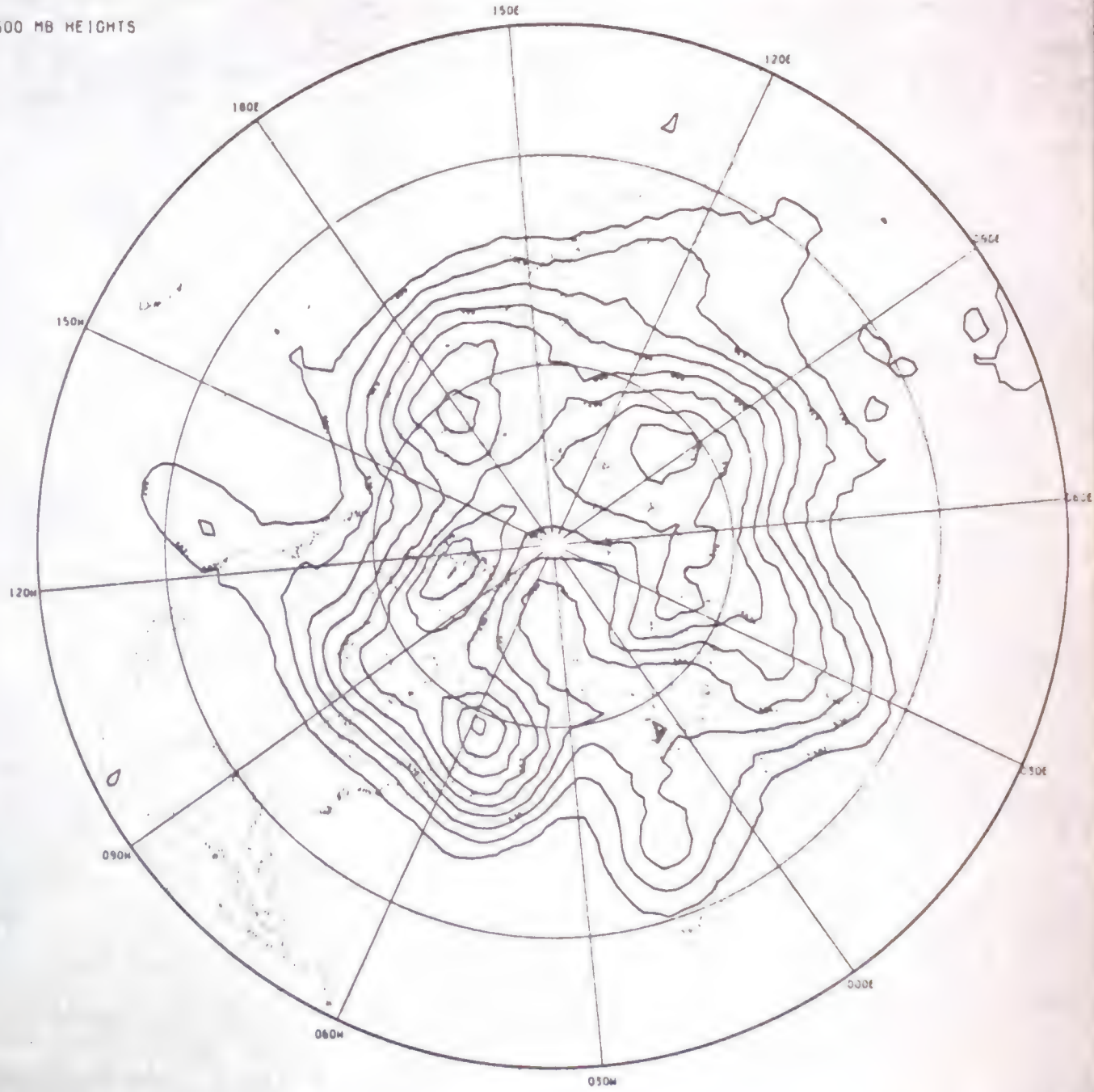

FIG. 7 10 LEVEL NO PHYSICS

DT 12Z 14/08/77 VT 12Z 17/08/77 T+72 500 MB HEIGHT ( 60M INT) UPDATE

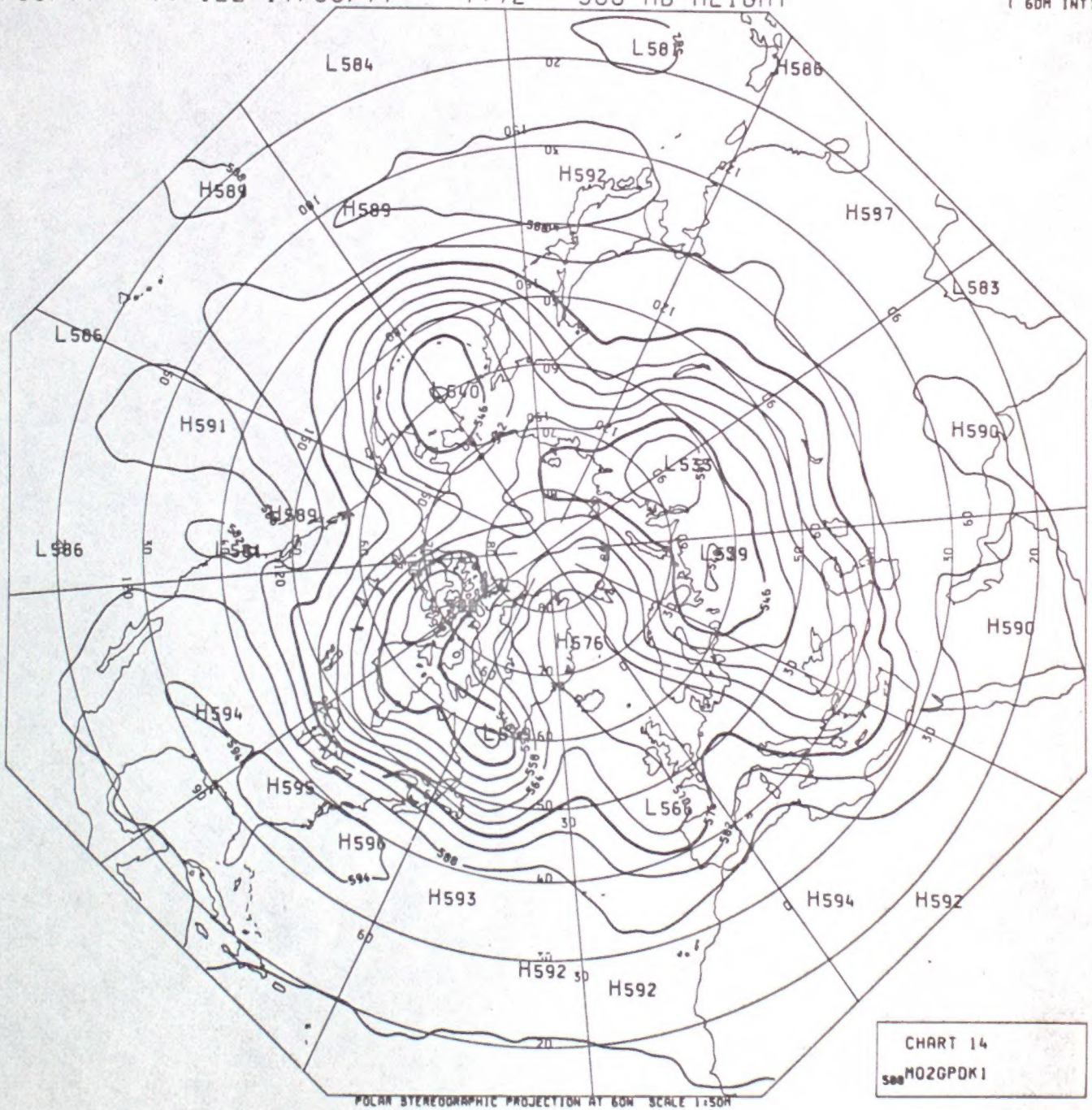

FIG. 8 11 LEVEL NO PHYSICS

EXPERIMENT TIME = 0003H00 500 MB HEIGHTS
CONTOUR INTERVAL = 6.00 DEKAMETRES

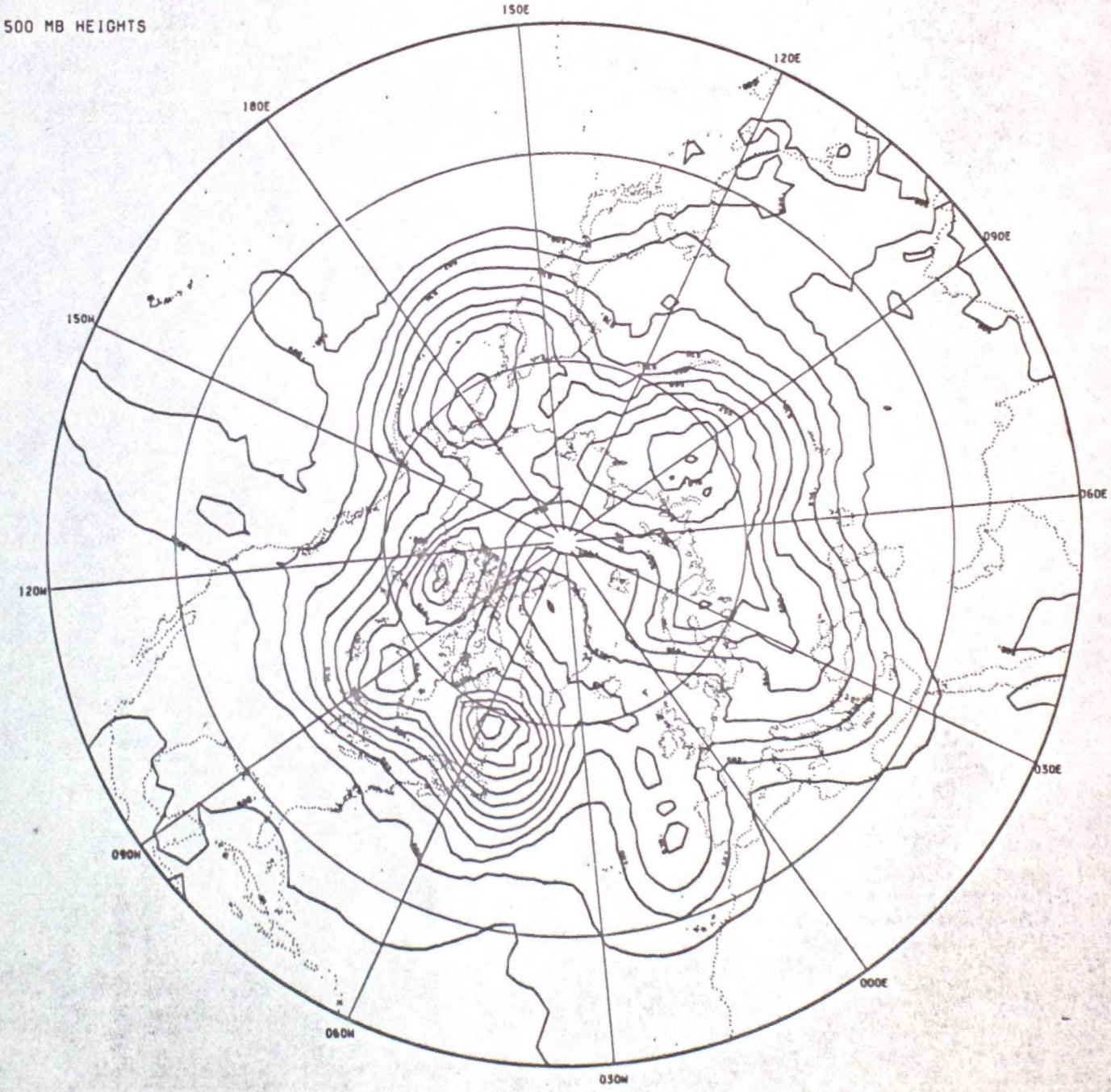

FIG 9 11 LEVELS

EXPERIMENT TIME = 0003H00 PMSL
CONTOUR INTERVAL = 4.00 MB

FIG. 10 11-LEVEL NO PHYSICS

EXPERIMENT TIME = 0003H00 PMSL
CONTOUR INTERVAL = 4.00 MB